

***CORRIGENDUM TO “EVALUATION OF SURFACE FLUX
PARAMETERIZATIONS WITH LONG-TERM ARM
OBSERVATIONS”***

Liu, G., Liu, Y., and Endo, S.

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1 **Corrigendum to “Evaluation of Surface Flux**
2 **Parameterizations with Long-Term ARM Observations”**

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5 Gang Liu

6 *Brookhaven National Laboratory, Upton, New York, USA, and School of Atmospheric*
7 *Sciences, Nanjing University, Nanjing, China*

8
9 Yangang Liu and Satoshi Endo

10 *Brookhaven National Laboratory, Upton, New York, USA*

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Corresponding author address: Gang Liu, School of Atmospheric Sciences,
Nanjing University, Nanjing 210023, China.
E-mail: gangliu@nju.edu.cn

1 We regret to acknowledge that in our original article (Liu et al., 2013), incorrect
2 results on the Eta and PX scheme were used in Figures 11, 12 and 15, which also
3 result in some incorrect subsequent discussions in Sections 4 and 6. This corrigendum
4 serves to correct these errors in the order of their occurrence in the original paper.

5 With Figure 11 corrected, the corresponding discussion on Page 787 in Section 4b
6 (5) is accordingly modified as:

7 “Figure 11 further compares the diurnal variations of the momentum (panel a),
8 sensible heat flux (panel c) and latent heat flux (panel e), respectively, in order to
9 examine the temporal dependence of the parameterizations’ performance. Also shown
10 in Figs. 11b, d and f are the diurnal variations of the corresponding standard
11 deviations, respectively. Figure 11a shows that in correspondence with the excellent
12 statistical agreement between the parameterized and EC momentum fluxes (Fig. 2), all
13 the parameterizations capture the diurnal variations to different degrees. All the
14 schemes overestimate the EC-observed momentum flux during the late morning and
15 afternoon, while the GISS and GFDL schemes produce the relatively largest standard
16 deviations, as shown in Fig. 11b.

17 Figure 11c shows that all the parameterizations qualitatively capture, but
18 quantitatively magnify, the diurnal cycle of the EBBR and EC-observed sensible heat
19 fluxes. The magnification of the diurnal cycle differs among the parameterizations.
20 Similar patterns of behavior hold for the diurnal variation of the corresponding
21 standard deviations. Figure 11e indicates that all the schemes are able to qualitatively
22 capture the observed diurnal variation of the latent heat flux. It is noteworthy that the

1 inter-scheme differences are somewhat larger than the two observational sets,
2 suggesting that either EBBR or EC observations can be used to assess parameterized
3 diurnal cycles of sensible and latent heat fluxes.”

4 With Figure 12 corrected, accordingly, the paragraph on Page 788 in Section 4b (6)
5 is changed as:

6 “Figure 12 compares the seasonal variations of the momentum (panel a), sensible
7 heat flux (panel c) and latent heat flux (panel e), as well as the seasonal variations of
8 the corresponding standard deviations (panels b, d and f), respectively. Figures 12a
9 and b show that the seasonal variations of the parameterized and observed momentum
10 fluxes are not that evident. For the sensible heat flux, Figs. 12c and d indicate all the
11 schemes capture the seasonal variations of the EC and EBBR observations well in
12 terms of both monthly mean and standard deviation, but the schemes significantly
13 overestimate the EC and EBBR observations in the monthly mean. In Figs. 12e and f,
14 the schemes also capture the seasonal variations of the EC and EBBR-observed latent
15 heat fluxes well. It is noteworthy that the EC and EBBR observations reach their
16 maxima around June and July whereas the parameterized fluxes peak in August. The
17 lag of the parameterized latent heat fluxes is probably due to the fact that the
18 saturation surface specific humidity at the surface skin temperature, not the actual
19 surface specific humidity, is used in the parameterizations. More study is needed to
20 improve the latent heat flux parameterization.”

21 Figures 15(b) and (c) are corrected, too.

1 All the corrections also result in some changes in Page 794 in Section 6
2 (Conclusions). The correct description should be:

3 “Statistical analysis shows that among the quantities examined (momentum flux,
4 sensible heat flux, latent heat flux, Bowen ratio, and evaporation fraction), the best
5 parameterized is the momentum flux. All six SFP schemes perform well with
6 parameterized momentum fluxes with only a small discrepancy between the different
7 schemes. Nevertheless, there are still differences in the functional dependence on
8 stability, suggesting the need for further improvement.

9 The sensible and latent heat fluxes observed by the EBBR and EC systems are in
10 reasonably good agreement with each other, although the discrepancy is still
11 noteworthy. The parameterized sensible heat and latent heat fluxes compare poorly
12 with the corresponding EC observations and all six of the SFP schemes underestimate
13 the sensible heat flux when the observed fluxes are positive. Relatively, the three
14 schemes used in the GCMs produce better estimates for the latent heat flux than do
15 those used in the WRF model. Furthermore, all the parameterization schemes tend to
16 exaggerate the magnitude of the diurnal variation of the sensible heat flux, although
17 they qualitatively capture the diurnal cycle. All the schemes also qualitatively
18 reproduce the diurnal cycle of the latent heat flux.

19 All of the parameterization schemes capture the seasonal variations of the sensible
20 and latent heat fluxes, but they significantly overestimate the sensible heat flux in all
21 months. Moreover, the seasonal maximum of the parameterized latent heat fluxes is
22 lagged for about 1 month compared to the EC and EBBR observations. The errors in

1 the parameterized sensible and latent heat fluxes are further magnified when they are
2 converted into their respective Bowen ratio or evaporative fraction, presenting higher
3 accuracy requirements for the SFP schemes.”

4
5 **Acknowledgement:** We would like to thank Dr. Pleim at the United States
6 Environmental Protection Agency for reading the paper carefully and drawing our
7 attention to these errors related to the Eta and PX scheme. The research is supported
8 by the U.S. Department of Energy’s ESM and ASR programs.

9
10 **Reference:**

11 Liu, G., Y. Liu, and S. Endo, 2013: Evaluation of surface flux parameterizations with
12 long-term ARM observations. *Mon. Wea. Rev.*, **141**, 773–797.

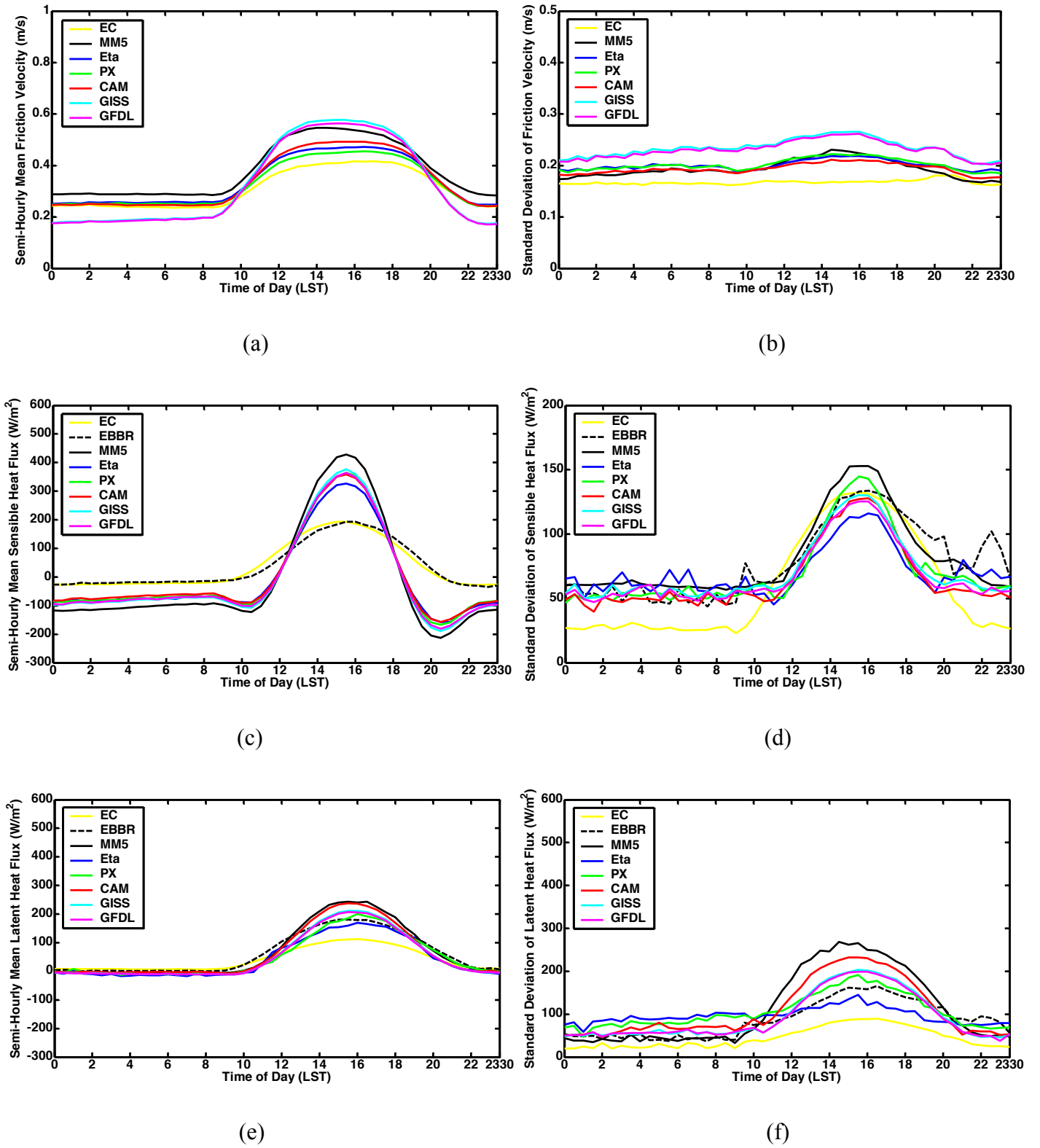


Figure 11. Comparison of diurnal variation of the surface turbulent fluxes between the parameterizations and EC observations: (a) semihourly mean of the momentum flux (friction velocity), (b) standard deviation of the semihourly mean of the momentum flux (friction velocity), (c) semihourly mean of the sensible heat flux, (d) standard deviation of the semihourly mean of the sensible heat flux, (e) semihourly mean of the latent heat flux,

and (f) standard deviation of the semihourly mean of the latent heat flux. The EBBR observation is treated as a parameterization here.

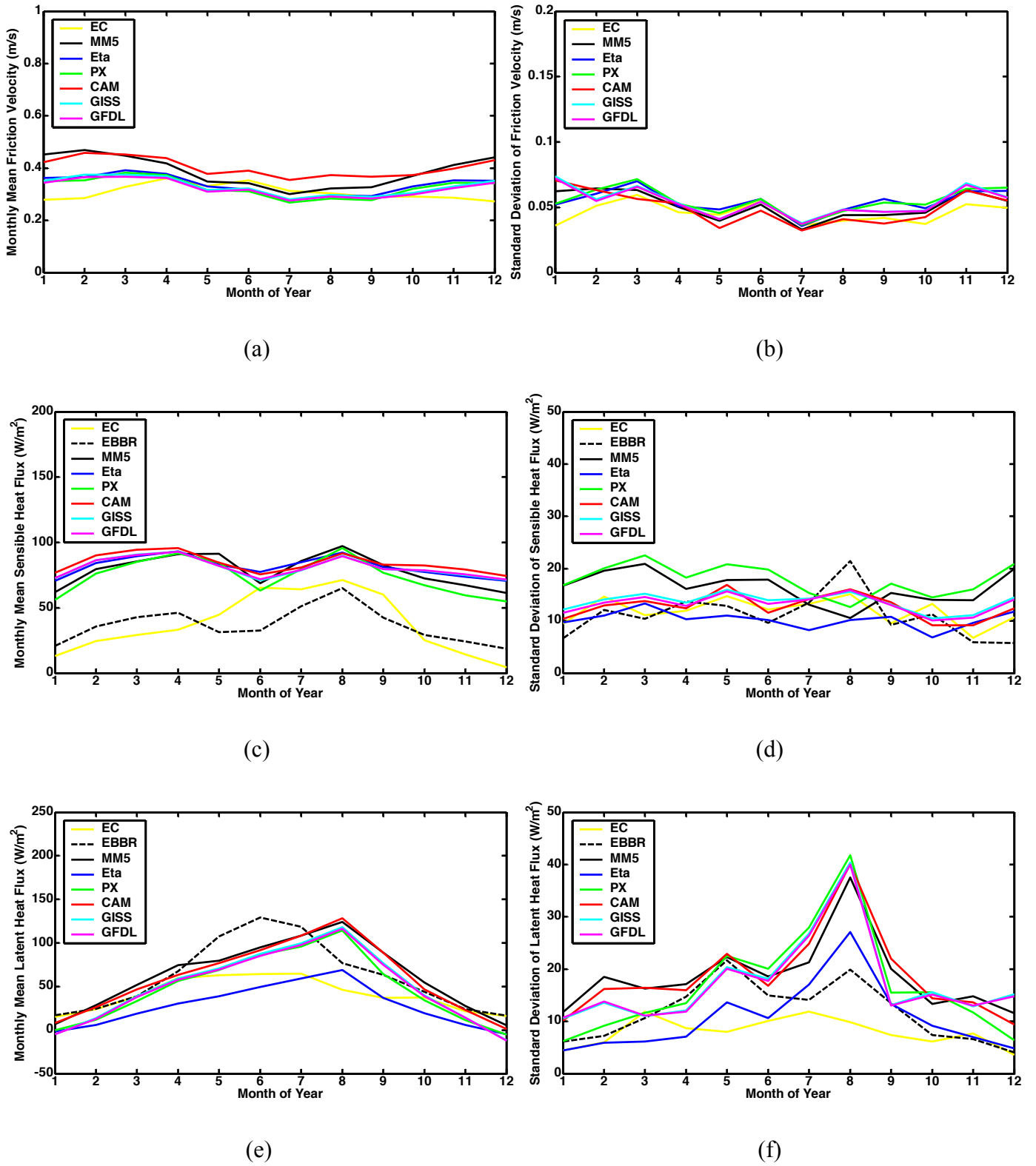


Figure 12. Comparison of seasonal variation of the surface turbulent fluxes between the parameterizations and EC observations: (a) monthly mean of the momentum flux (friction velocity), (b) standard deviation of the monthly mean of the momentum flux (friction velocity), (c) monthly mean of the sensible heat flux, (d) standard deviation of the monthly mean of the sensible heat flux, (e) monthly mean of the latent heat flux, and

(f) standard deviation of the monthly mean of the latent heat flux. The EBBR observation is treated as a parameterization here.

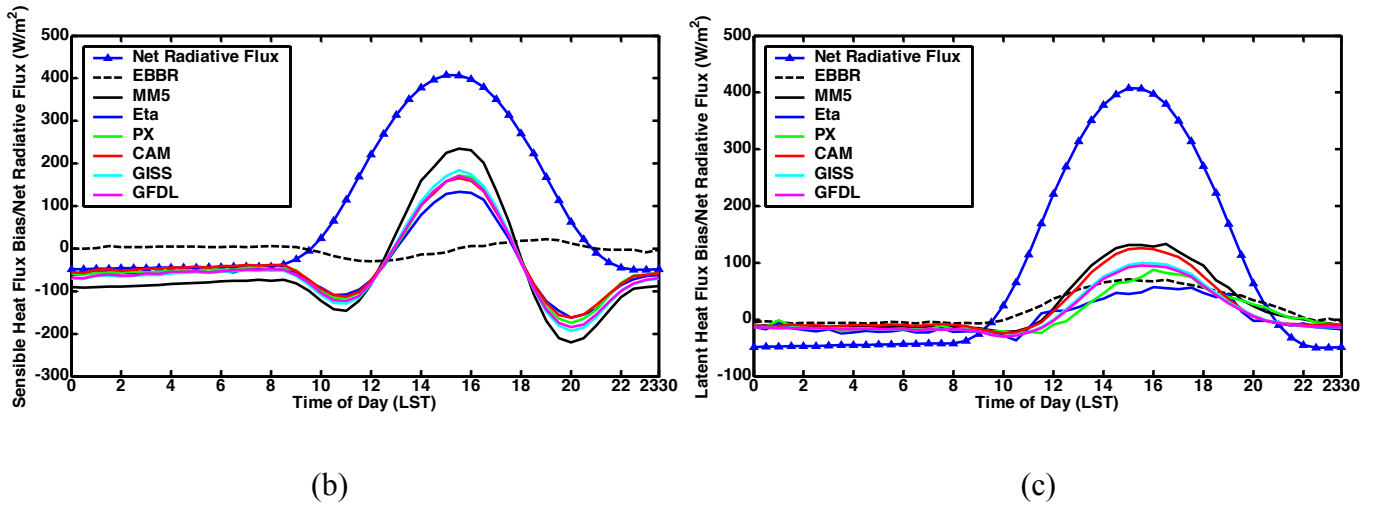


Figure 15. Semihourly mean of the temperature and flux differences varying with the surface net radiation. (a) The temperature difference is the surface radiative temperature minus the air temperature, and (b), (c) the flux difference is the parameterized surface flux minus the EC-observed surface flux. The EBBR observation is treated as a parameterization here.